EXTENSION NOTE

forest sciences
NELSON FOREST REGION

January 2001 EN-054

Case Study: Patch Cutting in Old-Growth Forests to Maintain Caribou Habitat, 1997-99 Research Results

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- **Timber, silvicultural, and caribou habitat objectives were met in this operational trial of harvesting timber with an alternative silvicultural system (patch cutting).**
- **One remaining question is: What is the minimal lichen dispersal and establishment rate for ensuring adequate forage for caribou at stand maturity?**
- **Alternative silvicultural systems can help maintain caribou habitat, but in the long term it may not be possible to maximize timber values *and* maintain the caribou herd.**

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BACKGROUND

In British Columbia, debate continues over the advantages and disadvantages of harvesting timber by clearcutting versus alternative silviculture systems. Concerns include harvesting cost and complexity, and potential for windthrow. Silviculture-related concerns include regeneration composition and growth, damage to the residual stand, possible spread of *Armillaria* root disease, and soil disturbance. Wildlife-related concerns focus on the short- and long-term abundance of arboreal lichens for mountain caribou forage, and the continuing presence of wildlife trees and coarse woody debris.

In 1994, the Revelstoke Forest District's Small Business Forest Enterprise Program (SBFEP) initiated an operational trial using a group selection system (patch cutting) in an old-growth stand, near Revelstoke in southeastern British Columbia. The objective was to use an alternative silviculture system to harvest timber, yet maintain old-growth attributes required by caribou for early winter habitat. The prescription development, harvesting operations, and preliminary results are described in Nelson Forest Region's Research Summary RS-029 (Waters 1996).

This Extension Note reports the results of post-harvest monitoring of regeneration, coarse woody debris, windthrow, and lichen.

SILVICULTURE PRESCRIPTION

For early winter habitat, caribou require large areas of old-growth forests with arboreal lichen and falsebox, and a closed canopy for snow interception. At this study site, one goal is to maintain early winter caribou habitat by developing a mosaic of stands with different age classes. Over a 240-year rotation, 25% of the total volume is to be removed every 60 years in a four-pass system.

Some of the specific objectives of the Silviculture Prescription include:

- Maintain mature and old-growth forest on 50% of the area in perpetuity.
- Provide wind-firm habitat.
- Maintain low evergreen shrubs.
- Minimize soil and vegetation disturbance.
- Maintain freedom of movement for caribou by limiting coarse woody debris.
- Maximize snow interception.
- Demonstrate the operational feasibility of using conventional methods to harvest patch cuts where small reserves of wildlife trees are retained.
- Establish suitable research trials to monitor silvicultural feasibility of this prescription as well as evaluate important caribou habitat attributes.

RESEARCH OBJECTIVES

The broad objectives of this research project are to develop and assess viable alternative silvicultural systems that allow economical timber harvesting while maintaining caribou habitat.

The specific objectives are:

- Investigate the effects of patch cuts on regeneration, windthrow, and coarse woody debris.
- Determine the impact of harvesting on the abundance and dispersal of arboreal lichen.

SITE DESCRIPTIONS

The main research area is at the Keystone study site, which is 50 km north of Revelstoke on Revelstoke Community Forest Corporation's (RCFC) TFL 56. It was conventionally harvested in the winter of 1995/96. The site is in the wet cool subzone of the Interior Cedar-Hemlock biogeoclimatic zone (ICHwk1); the elevation range is 950 to 1050 m, and the site is surrounded by old clearcuts. The gross area is 71 ha, with a total of 16 patch cuts ranging from 1.06 to 2.02

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ha; small wildlife tree reserves were retained within the patches (Figure 1).

Research on windthrow and lichen was also conducted on four additional sites north of Revelstoke, which were also harvested using patch cutting. Windthrow was monitored at the Gregson and Lookout Mountain sites, and the lichen retrospective research was conducted at the Sheill Road and Goldstream sites. For further information about these sites and the research, see Quesnel and Waters 2000a and 2000b.

RESEARCH RESULTS

Regeneration

The Silviculture Prescription stipulated that harvesting take place on a winter snowpack to minimize damage to low evergreen shrubs, which are an important food source for caribou during early winter. A post-harvest survey indicated that site preparation was required to create plantable spots due to the large amount of harvesting debris remaining on the site. A hoe piled the debris prior to seedlings being planted. The patches were planted in 1997 with a mix of cedar, spruce, and hemlock, and then were manually brushed once a year for three to four years.

A regeneration survey conducted by the SBFEP in 1999 indicated that the objectives of the Silviculture Prescription were being met, with 1000 well-spaced "planted" trees/ha, and 1260 total "planted" trees/ha. The planted trees averaged 60 cm tall. There are an additional 67 well-spaced "natural" trees/ha (100% western redcedar) out of a total of 640 "natural" trees/ha. The natural well-spaced trees averaged 30 cm in height. It is anticipated that natural ingress of cedar and hemlock will continue.

Coarse Woody Debris

A minimum of 15 m^3/ha of coarse woody debris (CWD) were to be left. A waste and residue survey conducted in 1997 indicated that five times the minimum amount of CWD was left on site. As a result, a hoe piled the CWD to permit planting and to facilitate wildlife movement. However, the piles were not burned to avoid further loss of CWD from the site.

Windthrow

Windthrow was monitored at the Keystone site for three years (1997-99), as well as at the Gregson and Lookout Mountain sites for one year (1999). Windthrow monitoring is planned for an additional two years (2000-2001) on all three sites.

Twenty-meter-wide transects (or strip plots) were located around the perimeter of recently harvested small patches and in unharvested areas. At each site, four treatments are being compared: the edges of the patches (1-2 ha) surrounded by mature timber; the unharvested buffers between these small patches; the edges of similar-sized patches along old clearcut boundaries; and large, unharvested areas in nearby forests.

Three years of data from the Keystone site show no statistically significant difference in the rate of windthrow density and basal area along the edge of patches, in the unharvested buffers, nor on the edge of small patches harvested along the boundaries of old clearcuts (Figure 2). Windthrow rates in the large unharvested area were comparable in magnitude to the unharvested buffer areas. Windthrow rates during 1999 were significantly less than the rates for the previous two years.

Data from the other two sites plus the large unharvested areas also indicate that there were no significant differences between the four treatments.

Of the three windthrow study sites, the Keystone site had the greatest values for windthrow density and basal area after one year, and the Lookout Mountain site had the lowest values (Figure 3). Relative to the pre-harvest stand

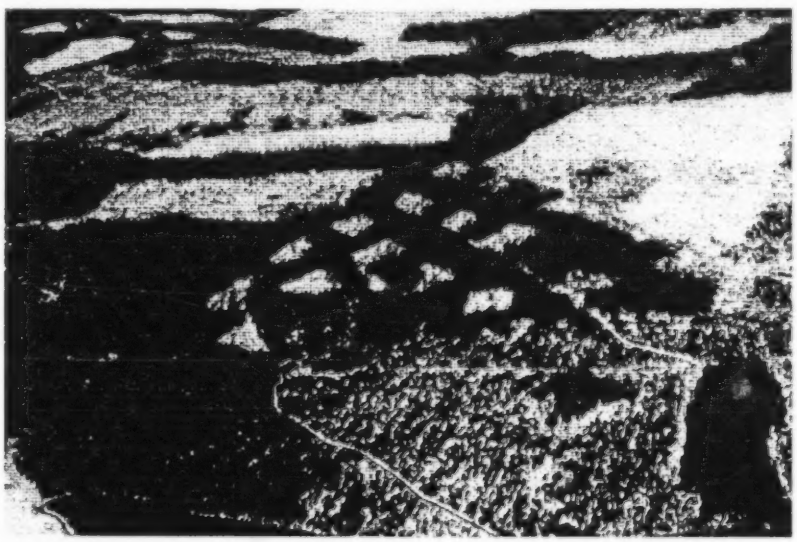

Figure 1. Aerial photo of Keystone patch cut site.

densities, overall windthrow rates of 0.006-0.6%/y are comparable to windthrow rates published for other mature or older forests (Coates 1997; Huggard et al. 1999). These rates reflect the relatively low occurrence of windthrow north of Revelstoke during 1997 to 1999.

Across all treatments and sites, most windthrown trees were dead (Figure 4). Most windthrown trees were dead western hemlock, followed by live western hemlock and western redcedar. These rates generally reflect the species composition of the original pre-treatment stand and are not a treatment effect. The orientation of windthrown trees and local valley systems indicate that easterly, followed by northerly or westerly, winds cause most of the windthrow on the Keystone site.

Windthrow rates for snags were unaffected by treatment. For example, the three-year average for the large unharvested area at Keystone (1.49 stems/ha) is comparable to values from the other three treatments (0.98-1.30 stems/ha). However, snags were more susceptible to windthrow than live trees. Pre-treatment stands were 7-11% dead while 41-51% of the windthrown trees were dead at two of the sites.

Stand Management Implications:

- Using small patch cutting (1-2 ha) to harvest timber does not result in a significant increase in windthrow rates.
- Dead trees are more susceptible to windthrow than live trees.
- Windthrow rates vary significantly from year to year.
- Refer to the *Windthrow Handbook for British Columbia Forests* (Stathers et al. 1994) for further information on managing for windthrow.

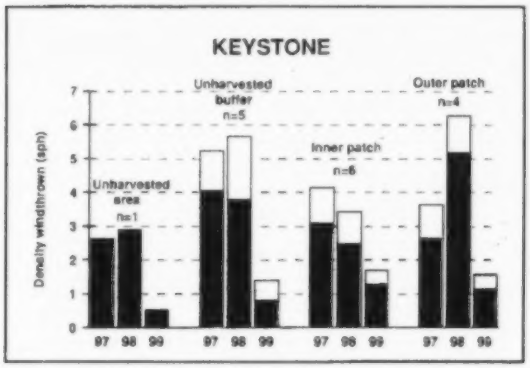

Figure 2. Windthrow density for four treatments over three years at Keystone. Solid bars represent the mean, open bars represent 1 standard error.

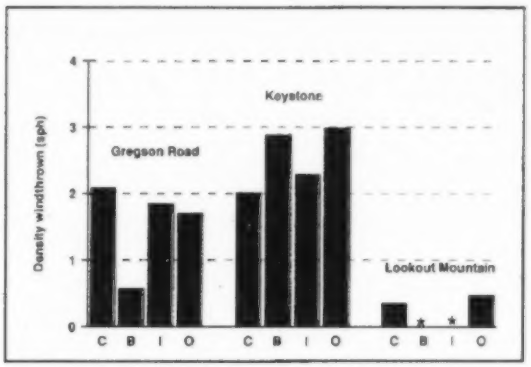

Figure 3. Windthrow density for four treatments at three sites. Values at Keystone represent average for 3 years, other values represent 1 year. * indicates windthrow not detected. C=unharvested area, B=unharvested buffer, I=inner patch, O=outer patch.

Lichen

Two separate but complementary studies of lichen dispersal and establishment were conducted. Lichen dispersal was studied at the Keystone group selection site for three years. Lichen establishment on young Douglas-fir plantations was assessed at two sites north of the Keystone site.

Lichen Establishment. Establishment of two lichen genera, *Alectoria* spp. and *Bryoria* spp., was assessed as a function of distance from mature timber on two 15-17-year-old plantations of Douglas-fir at the Sheill Road and Goldstream River sites. Mature to over-mature forests adjacent to these plantations are dominated by *Alectoria* spp. with minor amounts of *Bryoria* spp. Significant inverse relationships exist between biomass of lichen established on young Douglas-fir and distance from mature timber (Figure 5). Most lichen establishment occurred within 75 m of mature timber, and the proportion of *Bryoria* spp. established significantly increases with distance from the mature timber.

Lichen establishment was not significantly different among young Douglas-fir, western hemlock, Engelmann spruce, and western white pine. However, lichen establishment was significantly less on western redcedar (13% or less of the mean value found on other species).

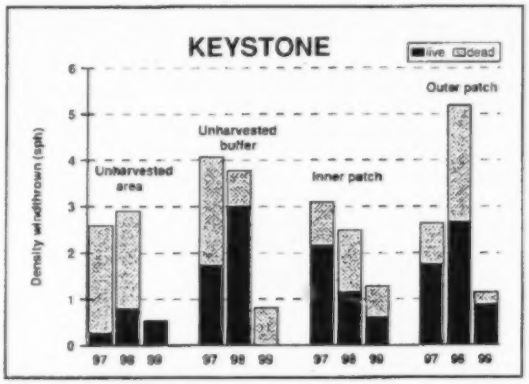

Figure 4. Density of live versus dead windthrow for three years at Keystone.

Lichen Dispersal. At the Keystone site the dispersal of *Alectoria* spp. and *Bryoria* spp. lichens was assessed using litterfall traps during 1997, 1998, and 1999 (Figure 6). The treatment units assessed for lichen dispersal included four patch cuts (1.0-1.78 ha). Dispersal rates of *Alectoria* spp. and total lichens within the patch cuts were greatest during 1999 and least during 1998 (Figure 7). Most of the dispersed lichen consisted of *Alectoria* spp., with the proportion of *Bryoria* spp. increasing with distance from the mature timber. The shift in lichen genera with distance from mature timber has been reported in other studies. Stevenson (1988) attributed this dispersal pattern to: the finer structure of *Bryoria* spp. yielding smaller fragments more readily carried by the wind, a greater frequency of *Bryoria* spp. with height in mature forests, and a possible underestimate of this genus in mature trees due to its dark colour.

Dispersal of both lichen genera was significantly greater in traps located within mature timber, compared with traps located 0-20 m, 20-40 m, and >40 m from the edge of mature timber (Figure 7). Although the rate of biomass dispersal for both lichen genera was slightly larger in the 0-20-m distance from mature timber, these values were not significantly greater than the values found at 20-40-m and >40-m distances. Thus, lichen dispersal within these patches occurred at a relatively uniform rate, although the rate varied from year to year. Lichen establishment and dispersal rates were observed to be higher at or near residual trees or wildlife tree reserves.

Stand Management Implications:

- In caribou management areas, small patch cuts are more desirable than larger clearcuts.
- Minimal lichen dispersal and establishment rates need to be determined to ensure adequate lichen foraging at stand maturity.
- Smaller opening sizes should be used and evaluated until the maximum distance of lichen dispersal and establishment compatible with caribou forage supply are known. Harvesting units should be limited in size to a maximum of 150 m X 150 m (2.25 ha).
- Rates for dispersal and establishment of *Alectoria* spp. and *Bryoria* spp. lichens are also affected by the lichen source (Stevenson 1988).
- The results of the present study can be applied to tree species selection when regenerating areas managed for caribou and lichens. However, despite the lower establishment rates observed in this study, western redcedar is an important component of old-growth stands used for foraging by caribou. As the growth form of western redcedar changes with age (e.g., greater exposed woody branches), this species may be more suitable as a substrate for lichen colonization in older stands.
- Lichen substrate is more critical than lichen dispersal.
- Lichen dispersal of *Bryoria* spp. is not limiting.

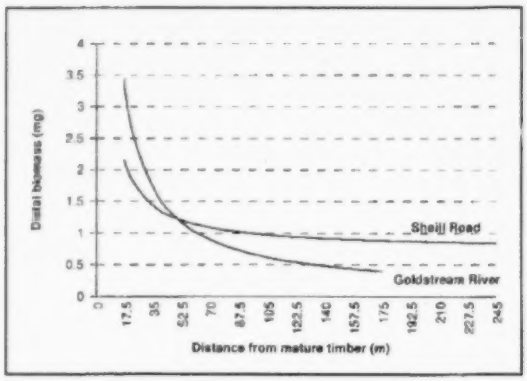

Figure 5. Establishment of lichen on young Douglas-fir versus distance from mature timber at two sites.

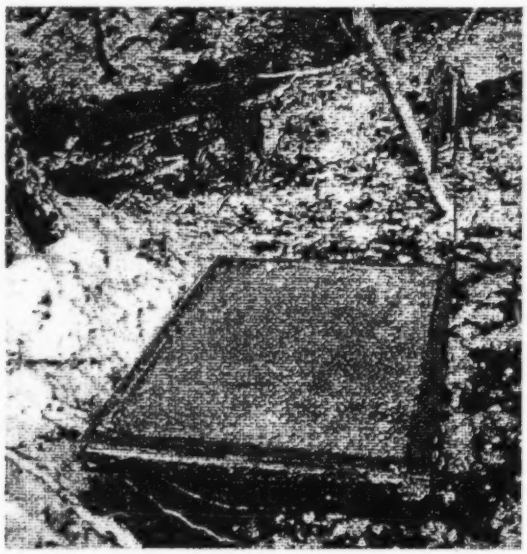

Figure 6. Lichen trap.

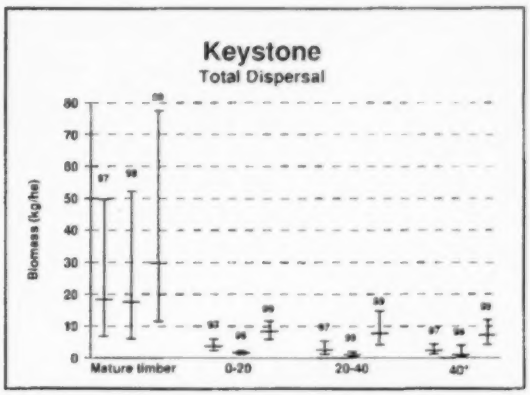

Figure 7. Three years of dispersal for total lichens (*Alectoria* ssp. + *Bryoria* spp.) relative to distance from mature timber.

CONCLUSIONS

The general consensus is that timber, silvicultural, and caribou habitat objectives have been met in this study of patch cutting. However, there is some debate about whether future harvesting passes will maintain caribou habitat. These blocks will continue to be monitored for windthrow.

This trial represents a valuable start to understanding the impacts of alternative silvicultural systems in caribou habitat. The experience gained in this research study should be used to design a more comprehensive set of trials in the Revelstoke area using different alternative silviculture systems, patch cuts of different sizes, and single-tree selection. One important question remaining is: What is the minimal lichen dispersal and establishment rate needed to ensure adequate forage at stand maturity?

As other alternative silviculture systems are considered for use in areas of caribou habitat in British Columbia, it is important to recognize that caribou appear to require large tracts of old growth. It may not be feasible to maximize timber values *and* maintain the caribou herd.

REFERENCES

Coates, D. 1997. "Windthrow Damage 2 Years After Partial Cutting at the Date Creek Silvicultural Systems Study in the Interior Cedar-Hemlock Forests of Northwestern British Columbia" in *Canadian Journal of Forest Research* 27:1695-1701.

Huggard, D.; W. Klenner; and A. Vyse. 1999. "Windthrow Following Four Harvest Treatments in an Engelmann Spruce—Subalpine Fir Forest in Southern Interior British Columbia, Canada" in *Canadian Journal of Forest Research* 29:1547-1556.

Quesnel, H.J. and L. Waters. 2000a. *Integrating Mountain Caribou Requirements and Forest Management in the Interior Cedar-Hemlock—Lichen Retrospective and Dispersal Study.* Prepared for Research Branch, BC Ministry of Forests. Victoria, BC.

———. 2000b. *Integrating Mountain Caribou Requirements and Forest Management in the Interior Cedar-Hemlock—Post-Harvesting Windthrow Rates.* Prepared for Research Branch, BC Ministry of Forests. Victoria, BC.

Stathers, R.J.; T.P. Rollerson; and S.J. Mitchell. 1994. *Windthrow Handbook for British Columbia Forests.* Research Branch, BC Ministry of Forests. Victoria, BC. http://www.for.gov.bc.ca/hfd/pubs/Docs/Wp/Wp01.htm

Stevenson, S. K. 1988. *Dispersal and Colonization of Arboreal Forage Lichens in Young Forests.* Integrated Wildlife, Intensive Forestry Research IWIFR-38. Wildlife Bulletin B-59. BC Ministry of Forests and BC Ministry of Environment. Victoria, BC.

Waters, Lauren. 1996. *Case Study: Patch Cutting in Old-Growth to Maintain Early Winter Caribou Habitat.* Research Summary RS-029. Nelson Forest Region, Nelson, BC. 4pp. http://www.for.gov.bc.ca/nelson/Research/SUMMARY/rs029.htm

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ACKNOWLEDGEMENTS

The authors appreciate the support and help provided by Bruce McLellan, Research Branch, BCMOF, Revelstoke; Susan Stevenson and Mike Jull, Prince George; Susan Hall, Parks Canada, Revelstoke; Steve Mitchell, Faculty of Forestry, University of British Columbia, Vancouver; Alan Vyse, Kamloops Forest Region, BCMOF; Peter Ott, Research Branch, BCMOF, Victoria; John Townley, Janice Hooge, and Kelly Stalker, Revelstoke; Deb DeLong, Nelson Forest Region, BCMOF, Nelson; Kathi Hagan, Campbell River; and Sonya Quesnel, Nelson.

Support from Forest Renewal BC is gratefully acknowledged.

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